

Petroleum and Tankers

by M. Megange

In 1914 only 3 percent of the world tonnage of merchant shipping used engines which burned mazut, and only 0.5 percent had Diesel engines. These percentages had increased to 30 percent and 23 percent, respectively, by 1938. Today more than three-quarters of the merchant marine uses petroleum, and the evolution is continuing, since 97 percent of the tonnage launched in 1948 is equipped with engines operating on liquid fuels. Furthermore, it should be noted that Diesel propulsion is accounting for a larger and larger share of the total.

The Evolution of the Tanker

Except for minor shipments of petroleum products in ancient times, problems of ocean shipping for petroleum did not develop until the second half of the nineteenth century. Kerosene or illuminating oil was packed in barrels and loaded on sailing vessels with wooden hulls. Fires were frequent. In 1862, however, a Canadian inventor conceived and produced a ship designed for the shipment of petroleum in bulk. The petroleum was loaded directly into the hold. Unfortunately the vessel sank on its maiden voyage, and the idea was temporarily abandoned. The system of using barrels was again adopted, with some improvements. Gradually ^{the} improvements led to the substitution of long iron cylinders laid along the axis of the ship, one above the other. They were not removable, and unloading was effected by the use of pumps on shore. Even though this vessel was a sailing ship with an iron hull, the risk of fire was still considerable because the air in the spaces around the cylinders became saturated with combustible vapor in spite of all precautions which could be taken.

The Nobel brothers became interested in the problem, and between 1870 and 1880 they constructed a series of tank ships specially adapted to the

transport of petroleum products on the Caspian Sea. The last one, the "Boudah", was built in 1879. It had an iron hull within which there ~~was~~ was a row of tanks shaped to conform to the shape of the hull; these tanks were separated by lengthwise and crosswise partitions, and above them there were expansion chambers designed to equalize expansion resulting from variations in temperature. The unloading pumps were located on the deck.

Six years later, in 1885, the first tank ship was built in Hamburg. It was christened the "Glückauf" and was designed for the bulk shipment of petroleum across the Atlantic. It had a deadweight tonnage of about 3,000 tons and a 200-horsepower engine located aft..... Except for the fact that it still had its pumps on deck, instead of in the body of the ship as in more recently built vessels, the "Glückauf" displayed all the characteristics of a modern tanker, and it required only a quarter of a century to ~~showing~~ ^{perfect} this type of ship. The tanker is now a special type of vessel; it may undergo further development, but it will not be basically transformed.

The Modern Tanker

more slender than
Low in the water and ~~slender~~ a freighter of the same tonnage, ~~the~~ a loaded tanker shows a characteristic silhouette. The freeboard represents between one-third and one-quarter of the total depth of the hull. The forward section is not very much built up, and the deck is quite clear. The central cabin, with three decks, is on the forward third of the vessel; it contains the salon, the quarters for the captain and the deck officers, the shipowner's cabin, the map room, the command post, the radio room, the ^{SCHE} equipment for taking soundings, perhaps radar equipment. There is a second cabin aft, with two decks differing in size and topped by a single large funnel. It ~~contains~~ contains the quarters of the mechanic's mate and of the crew, the galley and its equipment, the governor, and naturally the engine.

Running from the extreme forward section to the aft cabin, and on a level with the latter's ~~first~~ lower deck, in other words, along the central

axis of the ship, there is a passageway which permits passage from one cabin to the other in any weather. In heavy seas, waves break over the deck, which is then no longer accessible. Below the passageway there is a row of large pipes which serve, among other things, to carry steam. The deck is of metal, level or slightly curved. In various places there are shallow boxes, the covers of which can be raised ~~and~~ to permit access to the interior of the tanks. ~~Each of these covers has a corresponding set of valves,~~ whose multi-colored control wheels govern the internal network of pipe-lines. A pump room, general located ~~unknown~~ in line with the cabin and forward of it, perhaps with a secondary one aft, two short masts, ventilators above the pump rooms and above the engine room, two or three loading booms, and two life-boats alongside the cabin complete the picture of the tanker.

Depending upon its size, the vessel accommodates 40 to 50 crew members, whose extremely well-kept quarters attempt to compensate by a certain amount of comfort for the hard life on board vessels which ~~travel almost exclusively~~ ^{spend almost all their time} ~~at sea.~~ ^{at sea.}

~~The longitudinal cross-section of the hull~~

A longitudinal cross-section of the hull would show, from fore to aft: a forward hold above a ballast; a cofferdam; a series of three or four tanks divided crossways into three sections each/ (there are no expansion chambers -- protection against expansion is achieved by not filling the tanks full); a pump room; another series of five to eight tanks similar to those forward; a cofferdam; a storage tank for fuel; the engine room; and ~~at~~ ⁱⁿ the extreme aft section, storage tanks for drinking water or water for the engines. If the ship has a Diesel engine there are also one or more auxiliary boilers heated by mazut or by the ^{exhaust} gas when the engine is in operation. They furnish the steam necessary to operate the pumps and cranes, to clean the tanks, and perhaps to heat the oil in the cargo by means of serpentine tubes inside the tanks. One or more electrical generator units, and equipment to furnish compressed air to start the engine, complete the machinery.

A network of pipes at the bottom of the tanks links the tanks with one another and terminates on the deck, to permit loading and unloading of cargo.

On modern tankers there are ~~also~~ both alternating and rotary pumps, operated either by steam or by electricity. However, it appears that ^{electrically operated} rotary pumps will prevail in the near future. In loading and unloading it is possible to pump to or from all ~~own~~ tanks simultaneously or only to or from certain ones. It is also possible to transfer the cargo from one tank to another in order to ~~maintain~~ equalize the load. When traveling with a light load, the ship pumps sea water into the tanks to assure stability, more or less, depending upon the state of the sea. Although this is referred to as ballast, it should be noted that tankers do not have ballast tanks as such; the oil tanks fulfill this function. The ship also utilizes this operation, after it has just emptied a load under high steam pressure, to introduce outside air into the tanks through the orifices mentioned above, by placing cloth sleeves over the deck. This operation permits the removal of petroleum vapor, for the tankers have to be de-gassed at the port of loading. A tanker which has ~~been~~ unloaded and has not yet been de-gassed is more dangerous than a loaded tanker. A second network of pipes for the fuel permits the loading of the mazut storage tanks and also connects the tanks with the engine.

Protection against fire is assured by a device which permits the tanks to be saturated with a vapor which renders their atmosphere inert; also by foam apparatuses in case of an external fire.

The Principal Types of Tankers

If we consider the ships still in service at present, that is, the tankers less than thirty years old, we may distinguish three main types, as follows:

a. The 10,000-ton type, from 1920 to 1930: In 1921 the USA and Great Britain launched several tankers of very large tonnage, 19,000 or 20,000 tons, with turbine drive. However, the type which was most common during this period was about 10,000 - 11,000 deadweight tons (deadweight tonnage being the admissible weight for cargo, equipment, fuel, etc.), ^{about} 135 meters long, and had a speed of ten knots.

The type of propulsion was divided almost equally, at least at the

beginning of this period, between steam ~~engines~~ ^{engines} with triple-expansion engines, consuming 25 to 30 tons of heavy mazut per day, and Diesel engines consuming 12 to 15 tons of Diesel oil per day. The latter were produced almost exclusively in the shipyards of continental Europe. There were also a small percentage of turbine-driven tankers among the vessels of this period, built in English or American shipyards. Their consumption of fuel was slightly higher than that of similar vessels equipped with triple-expansion engines. It should be noted that the type of engine did not affect the speed, which was uniformly between 10 and 11 knots.

b. The 15,000-ton type of 1930 - 1940: From 1930 on the deadweight tonnage of ~~new~~ the newest vessels increased to 14,000 - 16,000 tons, the latter figure, in conjunction with a speed of twelve knots, being considered the most economical at the outbreak of the war. The triple-expansion engine had practically disappeared so far as new vessels were concerned. There remained only the Diesel, which predominated particularly in western Europe, consuming 14 to 17 tons of Diesel oil per day, and the turbine, which enjoyed a certain amount of favor in the USA and Great Britain; the latter's consumption amounted to 25 to 35 tons of ^{heavy} mazut per day, depending upon the speed, but the lower price of the crude fuel used by the turbine, heavy mazut, partly compensated for this inconvenience. Furthermore, the turbine was cheaper to buy and to maintain, so that it was able to compete with the Diesel engine, especially in the USA, where ship's mechanics were difficult to recruit.

c. The T-2: A war development, since 1939. The United States found it necessary to build a fleet of tankers speedily, and the T-2 SE.A1 was adopted. Its hull is entirely welded. Its deadweight amounts to 16,460 tons (including war equipment; commercial deadweight is between 17,000 and 17,500 tons). Its practical speed is 14.5 knots. It is 160 meters long, 20.75 meters wide, and has a draft of 9.2 meters when fully loaded. It is equipped with a watertube boiler which furnished steam at 400° and under a pressure of 32 kilograms per square centimeter to a turbine with electrical transmission, which develops 6,000 horsepower. Its fuel consumption is 40 to 45 tons of heavy mazut per day. Propulsion is by a single screw. Its

practical rate of unloading is 1,200 tons per hour. The pumps designed to pump the cargo are operated mechanically from the interior of the engine room, by means of electric motors.

This ship, which is remarkable in spite of certain defects due to the imperfect welding technique used on the hull, was produced in quantity; 481 were built, 30 of which were lost during the war. The remainder represent more than 35 percent of the transport capacity of the world tanker fleet.

Post-War Tendencies

In spite of its advantages, the T-2 is regarded as out-of-date. The tendency in new construction is toward vessels of higher tonnage. The largest vessel afloat at present is the "Ulysses", launched in 1947, the property of the American company "National Bulk Carriers". Its deadweight is 27,928 tons, and its operating speed is 16 knots. However, the United States has at present 56 tankers under construction which exceed 25,000 tons, four of them to be 30,000 tons. Propelled by a single screw driven by a gear turbine of 18,000 horsepower, the latter will attain a speed of 18 knots.

In addition to these ships already on order, a super-tanker of 40,000 tons is being designed in the USA. Also turbine-driven, it will be the fourth largest commercial vessel afloat. Its hull is said to have been designed by Vladimir Yurkevich, who also designed that of the "Normandie".

We should also mention that the "Welding Shipyards" in Norfolk are thinking of building tankers of 30,000 deadweight tons at the rate of one every four months, using only a single construction block.

Although also oriented toward large tonnages, European construction appears to be limiting itself to about 24,000 to 26,000 tons, with a speed of 13 - 14.5 knots and a length of 185 to 195 meters. Horsepower will be only 7,000 to 9,000. For reasons of operating economy European shipowners remain faithful to the Diesel engine, which under present conditions does not permit the development of as great a horsepower as the turbine and therefore also limits the speed.

It is interesting to note that in spite of the fact that the building

of giant ships is a normal tendency in maritime construction, inasmuch as doubling the size of a ship does not double the costs of construction or operation, nevertheless this tendency was not able to develop until the end of a thorough evolution of the international petroleum market.

Since refining originally took place almost entirely at the point of production, the increase in size of vessels was limited by the necessity of putting in at ports which varied greatly in water depth and in the capacity of storage facilities. A tanker of large tonnage was therefore ruled out for a great many routes.

However, since 1930 the shipment of crude petroleum has taken precedence over the shipment of refined products, and the centers of refining ^{production} have shifted from the points of ~~manufacture~~ to the points of consumption. The objections to ~~the~~ vessels of large tonnage no longer hold. Calls at secondary ports are made by ~~sea~~ coast vessels of small tonnage belonging to the refineries, while the refineries themselves have large storage capacities and deep ports available. The same is true for the loading ports, which are ~~also~~ also limited in number.

The majority of tankers therefore make ^{shuttle} runs, during which the length of time spent in port can be reduced to less than one day for loading and to two or three days for unloading.

Thus everything favors the large, fast tanker capable of loading and unloading within a few hours.

The World Tanker Fleet

The tanker fleet is the most important of the specialized fleets and represents a large part of the merchant marine in general. It ~~was~~ increased from 1,400 ships with a total deadweight of 17 million tons in 1938 to 2,016 vessels with 24,410,000 tons in 1949. At present, 30 percent of vessels under construction are tankers.

In general, there is a considerable disproportion between a country's importance as an importer or exporter and the importance of the fleet sailing under its flag. Some countries have a very great excess of capacity, and

their ships are used primarily to cover the needs of foreign countries; other countries -- the majority -- cover only a small part of their own requirements.

At present 72 percent of the world tanker fleet is sailing under the American, English, Norwegian, and Panamanian flags. At the end of 1948 the United States possessed 657 tankers with 9,328,000 deadweight tons; ~~the~~ ^{Frank} England had 463 ships with 5,177,000 tons; Norway had 209 ships with 2,740,000 tons; and Panama had 102 ships with 2,334,000 tons. The French oil fleet included 840,600 deadweight tons on 1 January 1949, to which should be added 23,500 tons for the ^{small} coastal vessels.

Considering the specialized use of tankers, it is not surprising that a large number of them belong to oil companies. At present ~~they~~ ^{oil companies} own almost half of all such vessels, whereas private shipowners control only 37 percent, the remainder being managed by the various governments. The principal fleets are those belonging to the Standard Oil Company (New Jersey), the Royal Dutch Shell, and the Anglo-Iranian, or their subsidiaries. So far as tonnage is concerned, these companies rival the largest shipping companies. For example, the Royal Dutch Shell group owns a tanker fleet of 2,135,000 tons, deadweight.

Since the war a great effort has been made to modernize the tanker fleet. In spite of this, it does not appear that tonnage will increase during the coming years in the same proportion as the requirements of petroleum products. Nevertheless, the shipping capacity will be adequate providing that international traffic ~~increases~~ develops in conformance with plans. An effort is being made to effect a redistribution between supplier countries and customer countries, which will tend to shorten the ^{shipping} distances.

The American importing countries will be supplied mainly by supplier countries on the same continent. The Middle East will supply Europe and Africa by means of large pipe lines, which will run from the Persian Gulf to the Mediterranean. Finally, the Far East will be supplied from the production in the Indonesian archipelago, which is being redeveloped.